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ABSTRACT

This study investigated the potential use of a cognitive measure to detect differential effects on children's styles of performance and behavior. A stratified random sample of 96 children across schools, sex and preschool attendance were selected for testing from the five kindergarten classes associated with the Mt. Druitt Early Childhood Project in New South Wales, Australia. Subjects were individually administered a Piaget and Inhelder task (the cognitive measure) which requires children to classify a given number of different objects in terms of whether or not the objects float on water. Children were required to experiment with the objects in a container of water and to describe their observations to an experimenter. Children's performance on the task was analyzed in terms of (1) the relationship between task orientation and previous attendance at preschool; (2) the relative press of different materials; (3) ability to classify and predict outcomes; and (4) the language utterances generated by the task. Significant differences in task orientation were found between children who had previously attended preschool and those who had not. The non-preschool group had more children whose task orientation was classified as inhibited. The order in which the objects were selected to be put into the water was uniform across individuals and programs. Sixty percent of the children were able to classify and predict whether objects would float or not. Finally, the task proved to be a successful means of stimulating young children's spontaneous verbalizations. (Author/MP)

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PROJECT EVALUATION REPORT

KINDERGARTEN CHILDREN'S PERFORMANCE
ON A PIAGETIAN TASK.

John Metham

PS011453

This draft paper reports specific aspects of evaluation activities not presented in detail in the Project's Final Report. Comments or requests for further information may be addressed to the Project, care of the above address.

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PREFACE

During the development of measures for the evaluation stages of the Mt Druitt Early Childhood Project, many attempts were made to devise alternative ways of evaluating children's performances and abilities. This brief report utilising a task described by Inhelder and Piaget, indicates some of the potential outcomes generated by the use of alternative evaluation measures.

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This Project is supported by the Bernard van Leer Foundation, the NSW Department of Education, the NSW Health Commission and the Smith Family.

This study investigated the potential use of a cognitive measure to detect differential effects on children's styles of performance and behaviour. Inhelder and Piaget (1958) describe a task which requires children to classify a given number of different objects in terms of whether or not they float on water. Further, the children are required to experiment with the objects in a container of water and to describe their observations to an experimenter. Inhelder and Piaget consider that until about 7 to 8 years of age children function at one of two sub-stages:

a) Substage (1-A) can be distinguished during which children do not even formulate the elementary dichotomy between floating and non-floating bodies. They are restricted to looking for the cause in the description of a particular case.

b) Substage (1-B) in which the child tries to classify the objects in a stable way into floating and non-floating groups even when they are incorrect.

This Piaget and Inhelder task was selected as being a developmentally appropriate, sensitive measure of one specific aspect of cognitive functioning suitable for investigating the following areas:-

1. The relationship between task orientation and previous attendance at preschool.

2. The relative press of different materials.

3. The suitability of the development stages described by Piaget and Inhelder for performance on this task in terms of ability to classify, ability to predict outcomes and types of errors made.

4. The language utterances generated by the task.

<u>The Sample</u>

A stratified random sample across schools, sex and preschool attendance were selected for testing from the five kindergarten classes associated with the <u>Mt Druitt Early Childhood Project</u>. (See Table 1) All subjects were aged between 4 years 9 months and 5 years 9 months with a mean age of 5.3 years.

TABLE 1: Composition of sample in terms of Program, Sex and Preschool Attendances

	School Programs									
	Cognitive		Competency		Contempor -ary		Behaviour -ist		Home-Based	
	M	F	M	F	M	F	M	F	M	F
Preschool	4	4	4	4	4	4	4	4	4	4
Non-Preschool	4	4	4	4	4	4	4	4	4	4
TOTAL	16		16		16		16		16	

The sample is part of a larger school-aged population classified as disadvantaged by the Australian Schools Commission. (1974)

Procedure

Children were interviewed individually in a pleasant outdoor area outside their own classroom. Care was taken to establish good rapport. A clear plastic trough of water approximately 1 metre long was sitting on a table of suitable height. The materials on the table at the beginning of an interview included a plastic frog, a plastic fish, a small doll, a metal toy car, a stone, a penny, a wooden cotton reel, a plastic peg, a rubber eraser, a wooden pencil and an empty tobacco tin with its lid. The task consisted of three sections: a) orientation, b) classification and c) prediction which were included in the one interview rather than being treated as discrete segments. Interviews lasted for approximately 10 minutes and took the following form:

a) The child was invited to play with the materials on the table. If the child was hesitant or appeared uncertain about what to do the interviewer suggested that he play with the toys in the water. The interviewer questioned the child about the behaviour of the objects in the water. If the child used other words to mean "sink" and "float", the interviewer used the child"s own words throughout the interview.

b) The interviewer asked the child to sort them into those that "float" and those that "sink".

c) The following pairs of objects (previously hidden from view) were presented to the child one pair at a time"- a lead sinker and a piece of cork, a rock and a wooden rod, a metal and a plastic spoon, a golf ball and a plastic ball. For each object the child was asked to predict what would happen if it was put in the water. The child then tested his prediction.

All objects were returned to the table and the child was asked to sort them into those that float and those that sink.

The interviewer put the doll in the car, clipped the peg onto the frog, put the penny in the tin and asked the child to predict for each of these 'conflict combination' objects to predict whether it would sink or float. The child subsequently tested each prediction.

A complete written record was made of the child's verbalisations and actions throughout the interview.

Results and Discussion

The results will be presented in the order indicated at the beginning of this article.

1. Task Orientation

The interview records were examined and two distinct patterns of behaviour were apparent in the children's approach to the task. One pattern was predominantly spontaneous, the other inhibited. Examples of spontaneous behaviours were "unsolicited exploration of the toys; uninhibited approach to the situation and active free play with the objects". Children displaying unhibited behaviour were ones that needed encouragement, who were anxious or timid or shy.

The only significant differences in task orientation were found between the preschool and non-preschool groups. The non-preschool group had more children whose task orientation was classified as inhibited (See Table 2).

TABLE 2: Task Orientation Task

TASK ORIENTATION	GROUP	
	Preschool N	Non-Preschool N
Spontaneity	20	14
Inhibition	20	26

$\chi^2 = 1.279$
$p < .01$

Three protocols classified as 'spontaneous' are included to demonstrate the nature of responses which can be expected from children of this age.

Protocol 1 Carl spontaneously and very quickly played with the car then put the frog, the penny, the whale and the doll in the water. He then made the doll dive and swim, touching it against all the objects in the trough. He tried to make the doll sink by holding it down. "Look! It's blowing bubbles". He played with the doll in the car pushing it around the desk. He placed the tin in the water and spun it around. The doll was then placed on the tin. "Wheee! I'll put the frog on the rock (the tin)". While making frog noises he placed the doll on the fish. "She's lying on the whale". The play became more elaborated, involved and detailed.

Protocol 2 Richard placed the whale, frog and doll in the water. "It's going to duck under." Made a humming sound and dropped the frog from a height. "What's this?" (Observer: A tin!) "Tin! I can't open this." (Observer opened tin.) "It's a rocket! Coming down! She (the doll) fell into the bucket. Jumps off building." Play became more complex. "This (reel) falls over. Comes back up!" Each object was incorporated into the fantasy. "This (pencil) can be the rocket. Can this (car) go in too? Penny! Did you hear the noise it makes?"

Protocol 3 Ricky: "Is that money? Cork! It floats! Frog! It floats!" He played with the car and the doll on the table. "Tin! It floats! I'll make it sink." Put car and penny on tin. Then rock and rubber. "It is getting heavier." Took the lid off the tin. "I want it to sink." (Observer: Why would it sink?) "Because it won't sink with lid." Played with doll on water. Stuck the doll in the car to keep the doll submerged. Put penny on cotton reel. Fantasy play with fish eating frog. "Pencil! It won't sink! Plastic peg! How come this doesn't float?" (Observer: Why did you think it would float?) "Because at home all the pegs float.

These few examples demonstrate the task's potential in generating language utterances with preschool-aged children. However, the main focus of this section, to detect differential approaches to the task, revealed two broad strategies labelled "spontaneity" and "inhibition".

2. The Press of the Materials

The order in which the objects were selected for putting in the water in section (a) of the interview was remarkably uniform across individuals and programs. Many children even asked for permission before putting some of the objects in the water e.g. car, pencil, peg. Their comments indicated that they thought some objects were not meant to be put in water. The mean order of selection is shown in Table 3. The order for each program is presented separately to stress the uniformity of the responses.

TABLE 3: Mean order of selection of objects for putting in water.

OBJECTS	PROGRAM				
	1	2	3	4	5
frog	1	1	1	1	2
whale	2	2	2	2	1
doll	3	3	3	3	3
car	4	3	4	4	4
reel	5	5	5	6	5
penny	6	6	8	5	6
peg	7	7	5	7	8
rock	8	8	7	9	9
rubber	9	19	9	8	7
pencil	19	9	10	10	10
tin	10	10	11	11	10

This strongly suggests that children may perceive the test stimuli in quite a different manner to that intended by the researcher. As far as the children were concerned only some of the available objects were legitimately associated with water. Research designers need to anticipate such unintended distractions as far as possible when preparing materials for young children.

3. Developmental Stages

Classification of First Set of Objects (Previously tested by child)

The objects in this set had already been 'played' with in the water and the interviewer had already asked 'leading' questions before the child was asked to sort the objects. Results are given in Table 4.

TABLE 4: Ability to classify objects in terms of floating and sinking.

Response	% of Total Sample
Correct	60.00
Incorrect	27.5
No response	12.5

Predictions - classification of untested objects singly and in combination.

Table 4 shows that the sixty percent of children could correctly predict whether objects would float or not. It is of interest to note that the conflict anticipated when the objects were combined did not appear to be operating. None of the children expressed awareness of the conflict. Those who had not responded in the first classification task were not questioned in this section.

TABLE 5: Ability to predict flotation of untested objects

Object	Correct Response	% predicting correctly
stone	sink	83
rod	float	66
lead	sink	77
cork	float	71
metal spoon	sink	61
plastic spoon	float	80
doll and car	sink	80
frog and peg	float	63
tin and penny	float	47

Level of Cognitive Functioning

Responses were analysed in terms of Inhelder and Piaget's substages and the results are presented in Table 6.

TABLE 6: Cognitive level of functioning - Number in each category.

LEVEL	GROUP			
	Preschoolers		Non-Preschoolers	
	Boys	Girls	Boys	Girls
No response	0	1	1	8
1-A	11	9	7	7
1-B	9	10	12	5

The following protocols illustrate 1-A level responses.

Protocol 1 "The rock sinks because it's big and black. The rod floats because it is long and skinny. It (the lead) sinks because it is really heavy. The cork floats because it's got two holes."

Protocol 2 "The rock sinks because it's heavy. The rod floats because it's little. The lead and the cork both will sink because they are little. The spoons will sink because they are both spoons. Both balls sink because they are balls. Things float because they want to stay up. Things sink because they want to stay down."

Protocol 3 "Some things drown and some things float. They drown because they are not a boat. This is a car and it doesn't float because it's got wheels. This (the penny) is a circle and it too doesn't float. The rest are not boats."

Protocol 4 (What happened to the things?) Some swim around. Some stayed under the water. (Why do you think these objects swim around?) Volunteered no reason but shrugged shoulders. (Could you put all the things back on the table?) The researcher mixed all the objects together. (Could you put the toys that 'swim around' together?). The child could not do the task. (What will happen when I put the rock in the water?) Swim around! (The lead!) Stays under water with the rock. (Cork!) Stays up! (How did you know?) I know because my teacher told me. (What will happen when I put the doll in the car and put them together into the water?) Stay under water. My mother told me. (What will happen when I put the peg on the frog?) Sat up! My grandmother told me.

The children in level 1-B consistently maintained that heavy things would sink and light things would float. That is, they attempted to classify the objects in a consistent way. If their predictions were wrong they were not swayed but attempted to explain what happened using the concept of weight. For example, one girl said: "It (the peg) felt light to me but must have felt heavy to the water." Another child predicted that the metal spoon would float. When it sank she commented, "It sank! Must be heavy." Researcher said to one child, "How could I make the tin sink?" The boy replied, "Put the rock in there. That makes it sink. Then it would be heavier."

The results offered some support for the homogeneity of cognitive functioning. Twenty preschoolers and 14 non-preschoolers were at level 1-A; whereas 19 preschoolers and 17 non-preschoolers were at level 1-B (see Table 5). It should be remembered that 10 children did not complete the task. There are no statistically significant differences between levels (χ^2= .259 is not significant at .01 level). Nor are there any statistically significant differences between sexes (χ^2= .206 is not significant at .01 level). The assumption made about the homogeneity of cognitive functioning is supported.

4. Language Generated by the Task

Besides the language already reported the following observations were made. Some of the words used for 'float' were: float, don't sink, swim, sail, and stayed on top. Some of the words used for 'sink' were: sink, drown, stayed on bottom, swim down, stay under, and went under. Both the words 'sink' and 'float' were used by 32 subjects. Reasons given for an object floating were: light, nothing in them, not heavy, won't sink, smooth, flat bottom, not rock and can swim. Reasons given for an object sinking were: heavy, hard, can't swim, rock, want to go down, have a rest, likes drowning, and big.

The task proved a successful means of stimulating young children's spontaneous verbalisations. It could be incorporated into a battery of language measures providing another situation in which children's language performance can be assessed.

Conclusion

The Piaget and Inheider task selected for this study seems a developmentally appropriate and sensitive measure to probe different -ial effects on children's styles of performance and behaviour. Specifically this task appears suitable for detecting heuristic skills; that is the various exploratory styles that children use to explore, discover and solve cognitive problems.

Inhelder, B. and Piaget, J. (1958). The Growth of Logical Thinking London: Routledge and Kogan Paul.